93008 22

INDIVIDUAL PROPERTY/DISTRICT
MARYLAND HISTORICAL TRUST
INTERNAL NR-ELIGIBILITY REVIEW FORM

Property/District Name: Bridge 2081 Survey Number: AA-765

Project: MD 436 over Weems Creek, Annapolis, MD Agency: SHA/FHWA

Site visit by MHT Staff: X no ___ yes Name ________ Date ________

Eligibility recommended X Eligibility **not** recommended ____

Criteria: X A ___B X C ___D Considerations: ___A ___B ___C ___D ___E ___F ___G ___None

Justification for decision: (Use continuation sheet if necessary and attach map)

Bridge No. 2081 is eligible for the National Register under Criteria A and C for Transportation and Engineering. Bridge No. 2081 is significant under Transportation as an xample of a movable bridge. Movable bridges have played an important part in the development of transportation in the United States and were once common features in areas with navigable waterways. Movable bridges are a rapidly disappearing bridge type. Of the more than 1,500 movable bridges constructed in Maryland, only twenty three remain. Of these, five are modern structures, built within the last thirty two years. Bridge No. 2081 is significant under Engineering as a rare example of a swing type bridge. Swing bridges were constructed in fewer numbers than bascule bridges in Maryland and are particularly rare today.

Bridge No. 2081 is a center-bearing swing bridge composed of thirteen 20-foot steel girder spans and two 48-foot pony steel truss swing spans. It is one of three remaining swing bridges in Maryland and is the oldest of the three. The other two remaining swing bridges were constructed in 1950 and 1932 and are located on the Eastern Shore and in Southern Maryland. Swing bridges were the most commonly constructed movable bridge type in Maryland through the early twentieth century, with the bascule bridge becoming more popular in later years. As a movable bridge, designed to accommodate both vehicular and water-borne traffic, Bridge No. 2081 is emblematic of Anne Arundel County's maritime heritage.

Documentation on the property/district is presented in: project file, SHA history of movable bridges, inventory form AA-765

Prepared by: Rita Suffness, John Hnedak

Elizabeth Hannold
Reviewer, Office of Preservation Services

4/29/93
Date

NR program concurrence: X yes ___ no ___ not applicable

R. Andersen
Reviewer, NR program

4-29-93
Date

Survey No. AA-765

MARYLAND COMPREHENSIVE HISTORIC PRESERVATION PLAN DATA - HISTORIC CONTEXT

I. Geographic Region:

___	Eastern Shore	(all Eastern Shore counties, and Cecil)
X	Western Shore	(Anne Arundel, Calvert, Charles, Prince George's and St. Mary's)
___	Piedmont	(Baltimore City, Baltimore, Carroll, Frederick, Harford, Howard, Montgomery)
___	Western Maryland	(Allegany, Garrett and Washington)

II. Chronological/Developmental Periods:

___	Paleo-Indian	10000-7500 B.C.
___	Early Archaic	7500-6000 B.C.
___	Middle Archaic	6000-4000 B.C.
___	Late Archaic	4000-2000 B.C.
___	Early Woodland	2000-500 B.C.
___	Middle Woodland	500 B.C. - A.D. 900
___	Late Woodland/Archaic	A.D. 900-1600
___	Contact and Settlement	A.D. 1570-1750
___	Rural Agrarian Intensification	A.D. 1680-1815
___	Agricultural-Industrial Transition	A.D. 1815-1870
X	Industrial/Urban Dominance	A.D. 1870-1930
___	Modern Period	A.D. 1930-Present
___	Unknown Period (___ prehistoric	___ historic)

III. Prehistoric Period Themes:

- ___ Subsistence
- ___ Settlement
- ___ Political
- ___ Demographic
- ___ Religion
- ___ Technology
- ___ Environmental Adaption

IV. Historic Period Themes:

- ___ Agriculture
- X Architecture, Landscape Architecture, and Community Planning
- ___ Economic (Commercial and Industrial)
- ___ Government/Law
- ___ Military
- ___ Religion
- ___ Social/Educational/Cultural
- X Transportation

V. Resource Type:

Category: Structure

Historic Environment: village

Historic Function(s) and Use(s): transportation

Known Design Source: Unknown

AA-765 1929

Weems Creek Bridge
Annapolis vicinity
public (unrestricted)

This bridge carries Maryland Route 436 over Weems Creek in Annapolis, Maryland. It consists of 13 twenty-foot steel beam spans and a swing span of 96 feet in length. The swing portion is a camelback pony truss.

As a moveable bridge, this structure is significant as a relatively rare kind of construct, designed to accommodate both vehicular and water-borne traffic. This bridge is one of three moveable bridges -- part of Maryland's state road system in Anne Arundel County, and one of 15 bridges of the same structural type throughout the state road network -- identified by the Maryland Historical Trust for the Maryland Department of Transportation in a jointly conducted survey during 1980-81.

AA-2081

MARYLAND HISTORICAL TRUST

AA-765

MAGI # 0207653817

INVENTORY FORM FOR STATE HISTORIC SITES SURVEY

1 NAME

HISTORIC

AND/OR COMMON
Weems Creek Bridge

2 LOCATION

STREET & NUMBER

CITY, TOWN
Annapolis X VICINITY OF

CONGRESSIONAL DISTRICT
4th

STATE
Maryland

COUNTY
Anne Arundel

3 CLASSIFICATION

CATEGORY	OWNERSHIP	STATUS	PRESENT USE	
__DISTRICT	X PUBLIC	X OCCUPIED	__AGRICULTURE	__MUSEUM
__BUILDING(S)	__PRIVATE	__UNOCCUPIED	__COMMERCIAL	__PARK
X STRUCTURE	__BOTH	__WORK IN PROGRESS	__EDUCATIONAL	__PRIVATE RESIDENCE
__SITE	**PUBLIC ACQUISITION**	**ACCESSIBLE**	__ENTERTAINMENT	__RELIGIOUS
__OBJECT	__IN PROCESS	__YES: RESTRICTED	__GOVERNMENT	__SCIENTIFIC
	__BEING CONSIDERED	X YES: UNRESTRICTED	__INDUSTRIAL	X TRANSPORTATION
		__NO	__MILITARY	__OTHER:

4 OWNER OF PROPERTY

NAME
State Highway Administration DOT Survey

Telephone #:

STREET & NUMBER
301 West Preston Street

CITY, TOWN
Baltimore __ VICINITY OF

STATE, zip code
Maryland 21201

5 LOCATION OF LEGAL DESCRIPTION

Liber #:
Folio #:

COURTHOUSE, REGISTRY OF DEEDS, ETC. Anne Arundel Co. Courthouse

STREET & NUMBER

CITY, TOWN
Annapolis

STATE
Maryland 21401

6 REPRESENTATION IN EXISTING SURVEYS

TITLE

DATE

__FEDERAL __STATE __COUNTY __LOCAL

DEPOSITORY FOR SURVEY RECORDS

CITY, TOWN

STATE

7 DESCRIPTION

AA-765

CONDITION		CHECK ONE	CHECK ONE
__EXCELLENT	__DETERIORATED	X UNALTERED	X ORIGINAL SITE
X GOOD	__RUINS	__ALTERED	__MOVED DATE______
__FAIR	__UNEXPOSED		

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

This structure, which carries Maryland Route 436 NW and SE over Weems Creek in Annapolis, consists of 13 twenty-foot steel beam spans and a swing span of 96'. The swing portion is a camel-back pony steel truss. The roadway is 23' wide. All truss connections are riveted.

CONTINUE ON SEPARATE SHEET IF NECESSARY

8 SIGNIFICANCE

AA-765

PERIOD	AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW			
__PREHISTORIC	__ARCHEOLOGY-PREHISTORIC	__COMMUNITY PLANNING	__LANDSCAPE ARCHITECTURE	__RELIGION
400-1499	__ARCHEOLOGY-HISTORIC	__CONSERVATION	__LAW	__SCIENCE
__1500-1599	__AGRICULTURE	__ECONOMICS	__LITERATURE	__SCULPTURE
__1600-1699	__ARCHITECTURE	__EDUCATION	__MILITARY	__SOCIAL/HUMANITARIAN
__1700-1799	__ART	X ENGINEERING	__MUSIC	__THEATER
__1800-1899	__COMMERCE	__EXPLORATION/SETTLEMENT	__PHILOSOPHY	X TRANSPORTATION
X 1900-	__COMMUNICATIONS	__INDUSTRY	__POLITICS/GOVERNMENT	__OTHER (SPECIFY)
		__INVENTION		

SPECIFIC DATES 1929 BUILDER/ARCHITECT

STATEMENT OF SIGNIFICANCE

(See M/DOT general bridge significance, attached, moveable bridges in particular).

CONTINUE ON SEPARATE SHEET IF NECESSARY

AA-765

9 MAJOR BIBLIOGRAPHICAL REFERENCES

Files of the Bureau of Bridge Design, State Highway Administration, 301 West Preston Street, Baltimore, Md.

Condit, Carl, American Building Art, 20th Century; New York, Oxford University Press, 1961.

CONTINUE ON SEPARATE SHEET IF NECESSARY

10 GEOGRAPHICAL DATA

ACREAGE OF NOMINATED PROPERTY

Quadrangle Name: South River
Quadrangle Scale: 1:24 000
UTM References: 18. 369360. 4316860

VERBAL BOUNDARY DESCRIPTION

NA

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE	COUNTY
NA	

11 FORM PREPARED BY

NAME / TITLE
John Hnedak/M/DOT Survey Manager

ORGANIZATION
Maryland Historical Trust

DATE
1980

STREET & NUMBER
21 State Circle

TELEPHONE
(301) 269-2438

CITY OR TOWN
Annapolis

STATE
Maryland 21401

The Maryland Historic Sites Inventory was officially created by an Act of the Maryland Legislature, to be found in the Annotated Code of Maryland, Article 41, Section 181 KA, 1974 Supplement.

The Survey and Inventory are being prepared for information and record purposes only and do not constitute any infringement of individual property rights.

RETURN TO: Maryland Historical Trust
The Shaw House, 21 State Circle
Annapolis, Maryland 21401
(301) 267-1438

AA 765

MOVABLE SPAN BRIDGES OF MARYLAND

REPORT PREPARED BY:

RITA M. SUFFNESS

ARCHITECTURE AND BRIDGE HISTORIAN

LEADER, CULTURAL RESOURCES GROUP

MARYLAND STATE HIGHWAY ADMINISTRATION

BALTIMORE, MARYLAND

1992

Revised: January 19, 1995

AA-765

MOVABLE SPAN BRIDGES OF MARYLAND

INTRODUCTION

Movable bridges have played an important part in the development of transportation in the United States. Engineers have always turned to this type when there was no other way of giving adequate vertical clearance for the passage of large vessels on a given waterway. The most widely recognized movable spans fall into three basic groups: the swing bridge, the bascule and the vertical lift. The movable bridge is understood to be as much as a product of mechanics as of engineering, as its distinguishing feature is the machinery necessary for the lifting or opening the span. Until 1890, when a satisfactory method of counterbalancing the great weight of a span had been found and the electric motor refined, neither the modern bascule nor the lift bridge could be developed.

HISTORY OF MOVABLE SPAN BRIDGES

Movable spans are required for bridges crossing navigable waterways to permit passage of vessels that would otherwise be blocked by an insufficient vertical clearance of structures that are either fixed or in the closed position.

The history of movable bridges probably extends back into the ancient past. Bascules, commonly thought of as drawbridges, were used over the moats that surrounded castles during the Medieval era and the pontoon bridges of the Romans may have had portions that could be removed in order to permit the passage of vessels. Hand-powered bascules were first used for this purpose, but they were necessarily limited to very small openings. These ancient and medieval examples, along with the earlier modern types, were not counterweighted to any extent and their field of utility was quite limited.

Most movable bridges are railroad structures, most commonly found in flat terrain. Typically it would have been prohibitively costly to build the necessary long approaches in steeper terrains because of the need to attain a high-level crossing while at the same time maintaining a low enough gradient for trains to climb. Movable span bridges are common in cities and in other built-up areas where construction of an elaborate approach is usually out of the question.

After 1830, when the network of railroads and canal systems spread rapidly over the eastern United States, the demand for movable bridges grew at a comparable rate. Among the earliest were those built across Boston's Charles River. These were crude forms of timber trusses placed next to the river bank, hinged at one corner and swung open by a system of radiating stays that supported it when open. The channel afforded by this opening was very narrow, but it seemed to suffice for navigation, and, as additional lines were needed after 1835, successive structures were built, each parallel with the last, until there were five in a row.

Apparently, the first patent on one of these timber jackknife bridges was granted in 1849 to a local contractor, Joseph Ross, who built one for the Eastern Railway at Manchester, Massachusetts shortly thereafter. The system was improved by the introduction of the center pivot swing bridge, basically the same type in use today. The new form was adopted by the railroads in the latter half of the nineteenth century, but as the bascule and lift bridges became available fewer and fewer swing spans were built.

Movable bridges may be divided into the following classes: (1) Ordinary swing spans; (2) bobtailed swing spans; (3) horizontal folding draws; (4) shear-pole draws; (5) double rotating cantilever draws; (6) retractile or pullback draws; (7) trunnion bascule bridges; (8) rolling bascule bridges; (9) jack-knife or folding bridges:(10) vertical-lift bridges; (11) gyratory lift bridges; (12) aerial ferries, transporter bridges, or transbordeurs; and (13) floating or pontoon bridges.[1]

The bob-tailed swing span (2) is a variation of the ordinary rotating draw formed by shortening one of the arms. The horizontal-folding draw (3) was used for short railway spans, and the girders revolve laterally ninety degrees. The shear-pole draw (4) was a special variety of swing bridge in which the pivot is located near one end of a single arm. When open, the other end of the arm is supported from the top of a two-legged shear pole, on the abutment, by rods which are attached to a pivot at its top, directly over the pivot supporting the span below. When the bridge is closed and the swinging end lifted, the arm is a simple span supported at both ends.

The double rotating cantilever draw (5) consists of two ordinary swing spans, each resting on a pivot pier and meeting at mid-channel. The pullback draw (6) is constructed with one or two spans over the entire opening and bottom chords run on two groups of rollers. [The bridge which immediately preceded the existing Scherzer overhead counterweight structure, built in 1934 over Knapps Narrows (#20001) was a pullback draw.] Some types telescope with each half of the opening spans (in a double pull-back draw) pulling back and telescoping into the approach span. The jack-knife or folding bridge (9) is a variant of swing bridge which is used only for railroads, in which, when opened, each half of the floor assumes the position of an inverted V. The vertical lift bridge (10), widely used throughout the United States but not utilized in Maryland, consists of simple spans resting on piers when closed. In most cases the weight of the lifting span is counterweighted by means of ropes, or chains, attached to the ends of the spans and the counterweights, which pass up and over sheaves on top of the towers at the end of the bridge.

AA-765

The gyratory lift bridge (11), patented by Eric Swensson of Minneapolis, consists of a truss suspended by trussed hangers from trunnions bearing on a tower at each abutment. The draw is opened by revolving the main roadway trusses in an arch around the horizontal longitudinal axis marked by the trunnions. The aerial ferries or transbordeurs (12) are a cross between a bridge and a ferryboat. It consists of two towers, an overhead span high enough to clear masts of ships and a track on the span, with a car running on the tracks and, finally, a platform suspended from the ferry car. The floating or pontoon bridge (13) may be the earliest type of movable bridge. It is usually adapted for use when local conditions prevent the construction of more stable structures and when a temporary crossing must be quickly made.

Of these thirteen types, only numbers 1, 7, 8, and 10 were in frequent use in the early twentieth century. Numbers 2, 5, 12, and 13 were employed occasionally and numbers 3, 4, 6, 9, and 11 were no longer used, according to Dr. John Alexander Low Waddell, the dean of American bridge engineers, in his 1916 text, Bridge Engineering.

Regardless of its limitation, the swing bridge was the only choice available until the end of the last century. One of the first notable examples in America was designed by Wendell Bollman to cross the Mississippi River at Clinton, Iowa. This bridge was built around 1863 by the Detroit Bridge and Iron Works. With its 360-foot draw span, it was one of the largest in the country at the time. Subsequently, the Mississippi became noted for its swing bridges, all of its many low-level crossings incorporating this form. The longest is the 525-foot crossing built by the Santa Fe Railroad at Fort Madison, Iowa in 1926. Since then all movable bridges of comparable length have been vertical lifts, a far more economical choice for larger spans.The various kinds of lift bridges were evolved in the endeavor to occupy less space and waste less time.

In the early twentieth century, builders of competitive types of movable bridges, especially the bascule, disparaged the swing bridge in their advertising by emphasizing the fact that the draw span itself took up part of the channel. Indeed, the wider the bridge, the narrower the passage. Because the bridge type requires a large pivotal pier in the center of the waterway on which to rotate, it not only divides an otherwise wider channel into two smaller halves, but the pier itself often causes serious deflections of the current to either bank. Another disadvantage of the swing bridge, as an impatient motorist would attest, is that it must be swung a full ninety degrees to open sufficiently to allow even the small vessel to pass and then close a full ninety degrees back. Furthermore, a swing bridge, when open, provides no protection to land traffic, while the leaves or counterweights of bascule designs provide a barrier to traffic. In addition, the dock front adjacent to a rotating draw is not available for business.

The promoters of the bascule bridge also touted the advantages specific to the bascule type that make it superior to the swing bridge. For one, it operates very rapidly, and with a choice of partially raising the span for the passage of vessels with small clearance or of opening it all the way up and leaving the channel unobstructed. Also, should a further track or roadway be required, another bascule can be built directly adjacent to the first, a solution obviously quite out of the question with a structure that swings.

The trend away from swing bridge construction and toward the other designs by the second quarter of the twentieth century is indicated by the following figures. In the period prior to 1924, among highway bridges, 25 vertical lift bridges, 250 bascule , and 450 swing bridges were constructed. From 1924 to 1974, 100 vertical lift bridges, 430 bascule and 250 swing bridges were completed.[2] Thus, vertical lift and bascule structures gained in popularity whereas other structures were constructed much less often. Currently, ninety-five percent of the total movable span bridges in the United States are swing, bascule, and vertical lift structures. There are no vertical lift bridges on the road system in Maryland.

The type of movable span bridge found most often in Maryland is the bascule bridge. In its most primitive stage, this type, the earliest of all movable bridges, was used to cross moats, or, in reverse, to deny any enemy access to a moated castle or fort by the simple device of withdrawing the span. These medieval bascules, with crude cables and no counterweights, were far removed from the technologically advanced modern bascule design. The forerunner of the modern type was developed in Europe during the first half of the nineteenth century. However, the real progenitor of the genre appeared in 1893 with the construction of Chicago's Van Buren Street Bridge, a rolling bascule, and in London's Tower Bridge, a roller-bearing trunnion bascule.

Bascule bridges may be single or double leaf, the single usually being used for short spans and the double for long ones. The most obvious advantage of the double leaf is that the two smaller leaves can be raised more quickly then a single larger one, and require smaller counterweights and moving parts. The cable lift bascule constitutes the earliest and most primitive of the bascules and has been largely abandoned in favor of the more modern and costly types.

Modern bascules are comprised of two classes: (1) the trunnion type; and (2) the rolling lift type. In the trunnion type the center of rotation remains fixed or nearly so and is at or close to the center of gravity of the rotating part. This is a highly desirable feature where yielding foundations are unavoidable. In the rolling lift type the center of rotation continually changes and the center of gravity of the rotating part moves in a horizontal line, thereby shifting the point of application of the load on the pier, which is a faulty feature, unless the pier is founded on rock. In the roller bearing type, a variant of the trunnion type, the center of rotation remains fixed and coincides with the center of gravity of the moving mass. The trunnion is eliminated and the load is carried by a segmental circular bearing on rollers arranged in a circular track. In this way the load can be distributed over a greater area, thereby reducing the unit bearing stress; at the same time the frictional resistance to rotation is decreased.

The first modern bascule bridge to enjoy acceptance was the so-called rolling lift bascule, the Scherzer and the Rall being the two best-known variations. After the success of the Van Buren Street bascule, the Scherzer rolling lift bridge became increasingly popular with the railroads, especially in and around Chicago. The Rall type, manufactured by the Strobel Steel Construction Company, was never widely used.

The most common recent types of bascule are the simple trunnion or Chicago type, introduced about 1899 and named after the city that pioneered it with the Clybourne Avenue Bridge, and the multiple trunnion or Strauss type, named after the inventor J. B. Strauss. In the Chicago type, the whole weight of the leaf and its counterweight is borne by the trunnions located at the center of gravity of the entire mass. The most popular system by far was Strauss's bridge, either of the overhead-counterweight or heel-trunnion variety. Other varieties of trunnion bridges are the Page, Chicago City, Brown, and Waddell & Harrington types.

The early decades of the twentieth century were dominated by patented designs--Strauss, Scherzer and others--fabricated by numerous shops, many of which are no longer in existence. Designs were furnished by the patentee to fit a substructure designed for the site. Between 1873 and 1924, for example, 78 patents were issued for movable span designs and mechanisms. The major patenees were T. E. Brown, J. P. Cowing, C. L. Keller, J. W. Page, T. Rall, W. and A. Scherzer III, J. B. Strauss, J. A. L. and M. Waddell and B. L. Worden. Both Strauss and Scherzer received patents that had counterweights either above or below deck level, and were used for both railroad and highway service. In addition to the patented designs, custom designs were prepared by a limited number of consulting engineers.

Patented designs and custom designs were produced in this period, each having its place depending on the desire of the owners and on the adaptability of the patented design to special requirements and unusual site conditions. Certain locations warranted monumental structures that in general were custom designed for the site. Elaborate decorative treatment was included in many of these.

By the 1940's patented designs were mostly in the public domain. Thus companies that had primarily promoted and used their own designs in the early decades of the twentieth century utilized many designs in the later decades which were no longer patented. Waddell and Harrington, for example, patented a bascule design (#952,485) in March 1910. By the time the successor firm, Waddell and Hardesty, submitted designs for Bridges 17006 and 2053 to Maryland State Highway Administration in the late 1940's and early 1950's, the movable span mechanisms utilized were no longer covered by patents.

In the period from 1941 to 1956 World War II and the post-war expansion occurred. Little civilian construction was done during the war years but the post-war boom in population was accompanied by a decline in dependence on rail travel and a substantial increase in automotive travel. The increases in vehicular travel necessitated widening of existing primary highways, many of which required replacement of older inadequate movable bridges with new larger structures. New four-lane and six-lane structures were common. Pressure to replace movable span with high level bridges was beginning to be felt, as motorists did not want to wait for movable bridges to be opened. This trend was further accelerated with the shift of focus and funds in the late 1950's to the building of the interstate system, which had few movable span bridges.

The general economic health of the railroads began its decline in this era and the new movable-railroad bridges were generally built only as a result of Federal aid for river improvements like channel widening or other subsidized construction. Patented designs faded from popularity in this period because of expiration of the patents, death of the patent holders and increasing sophistication on the part of the owners for structures designed to their particular requirements.

<u>TYPES OF MOVABLE SPAN BRIDGES IN MARYLAND</u>

I. **SWING BRIDGES.** These bridges consist of two-span trusses or girders which rotate horizontally. The spans are usually, but not necessarily, equal. When open, the swing spans are cantilevered from the pivot (center) pier; when closed, the spans are supported at the pivot pier and at two rest (outer) piers or abutments. In the closed condition, wedges are usually driven under the outer ends of the bridge to lift them, thereby providing a positive reaction sufficient to offset any possible negative reaction from live load and impact. This design feature prevents uplift and hammering of the bridge ends under live conditions. Swing spans are subdivided into:

A. Center-Bearing. This type of swing span carries the entire load of the bridge on a central pivot (usually metal disks). Balance wheels are placed on a circular track around the outer edges of the pivot pier to prevent tipping. When the span is closed, wedges similar to those at the rest piers are driven under each truss or girder at the center pier. This relieves the center bearing from carrying any live load. However, these wedges do not raise the span at the pivot pier, but are merely driven tight. Maryland currently has four swing spans on the road system and these are center-bearing structures.

Bridge 2081 (MD 436 over Weems Creek), built in 1929, is composed of thirteen 20-foot steel girder spans and two 48-foot pony steel truss swing spans. It was built under contract to the Commissioners of Anne Arundel County.

Bridge 4008 (MD 231 over Patuxent River), designed by the J. E. Greiner Company in 1950, has a through steel girder swing span.

Bridge 20023 (MD 331 over Choptank River), constructed in 1932 and also designed by the J.E. Greiner Company, is composed of two 215-foot through steel trusses, eight 24-foot concrete slab spans and a 219-foot swing span. It is known as the Dover Bridge.

B. Rim-Bearing. This type of swing span transmits all loads to the pivot pier, both dead and live, through a circular girder or drum to bevelled rollers. The rollers move on a circular track situated inside the periphery of the pier. The rollers are aligned and spaced on the track by concrete spacer rings. This type of swing span bridge also has a central pivot bearing which carries part of the load and is connected to the rollers by radial roller shafts. On both types of swing bridges, the motive power is usually supplied by an electric motor, although gasoline engines or manual power may also be used. The bridge is rotated by a circular rack and pinion arrangement.

II. **BASCULE BRIDGES.** In this type of bridge the leaf (movable portion of the decks) lifts up by rotating vertically about a horizontal trunnion (axle). This trunnion is positioned at the dead load centroid. Bascule bridges may be either single or double-leafed. In the former case, the entire span lifts about one end. A double-leafed bascule has a center joint and half of the span rotates about each end. It is obvious that a counterweight is necessary to hold the raised leaf in position. In older bridges, the counterweight is overhead, while in the more modern bridge, the counterweight if often placed below deck and lowers into a pit as the bridge is opened. When the bridge is closed, a forward bearing support located in front of the trunnion is engaged and takes the live load reaction. On double-lead bascule bridges, a tail-lock behind the trunnion and a shear lock at the junction of the two leaves are also engaged to stiffen the deck. There are several varieties of bascule bridges, but the most common are:

A. **Chicago (or simple) trunnion.** This variety of bascule bridge consists of a forward lead and a rear counterweight arm which rotates about the trunnion. The trunnion bearings, in turn, are supported on the fixed portion of the bridge such as a trunnion girder, steel columns or on the pier itself.

Bridge 23002, the Snow Hill Bridge carries MD 12 over the Pocomoke River. Designed by the J.E. Greiner Company in 1932, it is composed of single 47-foot steel girder and a 45-foot single leaf bascule.

Bridge B147 carries Penninsula Expressway over Bear Creek. Although the Wilson T. Ballard Company designed the approach spans and roadway in 1958, the Diver Brothers Company may have designed the bascule span in 1960.

The Pennington Avenue Bridge (BC5217) over Curtis Creek was designed in 1976 and is also a trunnion. It was designed by Zollman Associates.

Bridge 2045 over Stony Creek was built in 1947. Is composed of fifteen 54-foot steel beam spans and a 75-foot double leaf bascule span.

Bridge 2053 carrying MD 181 over Spa Creek, was designed in 1946 by Waddell and Hardesty, a New York firm, and is composed of fourteen 55-foot steelbeam spans and a 62-foot double leaf bascule.

Bridge 17006, which formerly carried US 50/301 over Kent Narrows, but currently carries MD 18, was built by the same firm in 1952. It replaced an overhead counterweight bridge. Neither of these latter two bridges utilized a bascule design which was patented according to Mr. Richard W.Christie of Hardesty and Hanover, the successor of Waddell and Hardesty, as the heyday of patents had passed and all designs were more or less in the public domain.[3]

Bridge 22009 carries MD 991 over the Wicomico River and is composed of one 40-foot double leaf bascule. It was built in 1928 and carries Main Street over the Wicomico River in Salisbury, Maryland.

Bridge 22028, designed by the J.E. Greiner Company in 1962, carries US 50 over the Wicomico River. It is composed of a 19-foot and 36-foot steel beam spans and a 66-foot single leaf bascule.

B. Rolling Lift (Scherzer) Bridge. This type is commonly known as a bascule, but the term "rolling lift" is more correct, according to bridge historian Otis Ellis Hovey. This is a bridge type whose complete superstructure, forward leaf or span itself, rear arm, and counterweight rolls back from the channel. This is accomplished with a quadrant or segmental girder whose center of rotation is at the centroid of the bascule. The girder rims roll along a toothed track and in so doing lifts and withdraws the leaf. A horizontal retraction of a cable or rack attached to the centroid of the bascule leaf produces this motion.

Seventeen bascule spans were built in Maryland prior to 1960 and are still open to traffic. At least seven are Scherzer designs and five were designed by the J.E. Greiner Company.

The oldest is bridge <u>23004</u>, designed in 1920, which carries MD 675 over the Pocomoke River. It is a double leaf bascule bridge composed of four 36-foot concrete girder spans, two 13-foot girder spans and a 65-foot double leaf bascule span.

Bridge <u>9001</u>, which carries MD 14 over Marshyhope Creek, was designed by the J.E. Greiner Company in 1931. It is composed of eight 35-foot concrete girder spans and a 60-foot double leaf bascule. Not opened since the 1970's, it is not possible to operate it mechanically.

Bridge <u>9008</u>, carrying MD 795 over CambridgeCreek, was designed in 1938 by the Henry G. Perring Company, a Baltimore firm. It is composed of six 35-foot concrete girder spans and a 64-foot double leaf bascule.

Bridge <u>20001</u>,carrying MD 33 over Knapps Narrows, was built in 1934 and is composed of two 15-foot and one 20-foot timber spans and a 50-foot single leaf bascule. It was built to replace a pullback draw bridge, the only one known to have ever existed in Maryland.

Bridge <u>14027</u>, designed in 1930, is made up of thirty-four 35-foot concrete girder spans, four 33-foot concrete girder spans and a 89-foot double leaf bascule. It carries MD 213 over the Chester River in Chestertown. The entire superstructure was replaced in the late 1980's.

Bridge <u>23007</u>, carrying US 50 over Sinepuxent Bay, has sixty-eight 28-foot concrete slab spans, a 77-foot steel beam span and a 70-foot double leaf bascule. It was built in 1942.

The final structure, <u>B79</u>, which carries Wise Road over Bear Creek, was likewise designed by the J.E. Greiner Company in

1943.

C. Rall Lift. This is a variation of the rolling lift bascule bridge in which the segmental girder is replaced by a large roller at the bascule's centroid. To open the bridge, the roller moves backward on a horizontal track. The only Rall structure known at this time to have been constructed in Maryland is bridge BC5210 which carries MD 2 (Hanover Street) over the Middle Branch of the Patapsco River. It was constructed in 1916 to plans developed by the J.E. Greiner Company, and is the oldest movable span structure remaining on Maryland highways.

D. Strauss Bascule Bridge. There have been more bascule spans built from the various Strauss designs than from those of any other single type of bascule according to Otis Ellis Hovey in his 1926 text on movable span bridges.[4] The Strauss class of bascule bridge employs four trunnions connecting the sides of a parallelogram-shaped panel formed by the lift span and a fixed triangular rear panel. The principle trunnion about which the movable span rotates is at the heel of the truss. This parallelogram, in some form, is used in practically all of the Strauss bascule designs.

Strauss designs are of three general types: (1) the vertical overhead counterweight type; (2) the underneath counterweight type, (3) the heel trunnion type. With the underneath counterweight type the counterweight is lowered along a vertical axis below the road level. It may be cored out to clear the floor framing when a compact arrangement is necessary. When two leaves are used, the front shear locks and rear anchorages must be provided. The dead load on the trunnions is constant and the break in the floor is in front of the trunnions.

The only Strauss movable span which existed in the late twentieth century in Maryland was bridge 2070 carrying MD. 450 over the Severn River. Constructed in 1924, it is composed of approximately twenty 70-foot steel arches and a 95-foot bascule span. In the late 1970's the four spans at the eastern end of the bridge were replaced with four steel beam spans. It is an underneath counterweight type in which the counterweight is lowered along a vertical axis below the road level. This bridge was removed in 1994.

In 1995 there were twenty-two movable span bridges in Maryland, reduced from twenty-four in 1992 with the removal of Bridge No. 9014 in 1992 and Bridge No. 2070 in 1994. There are two modern replacement structures: Bridge No. 20018 (MD 370 over Miles River), and Bridge No. 14006 ((MD 213 over Sassafras River). Four other structures are also quite recent: Bridge No. 16173 (I-495 over the Potomac River) was built in 1961, Bridge No. 22028 (US 50 over the Wicoimico River) was built in 1962, Bridge No. B147 (Penninsula Expressway over Bear Creek) was built in 1960 and Bridge No. 5217 (Pennington Avenue over Curtis Creek) was designed by Zollman Associates in 1976. These structures have little historical interest.

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FOOTNOTES

[1] Waddell, J. A. L. Bridge Engineering, Volume I (New York: John Wiley and Sons, Inc. 1916, p. 664

[2] Hardesty, Egbert, Henry W. Fischer, Richard W, Christie, "Fifty-Year History of Movable Bridge Construction-Part I", Journal of the Construction Division, ASCE, September, 1975, p. 512.

[3] Personal communication with the author.

[4] Hovey, Otis Ellis, Movable Bridges, Volumes I & II, John Wiley & Sons, Inc., New York, 1926, P. 116.

SOURCES

Hardesty, Egbert, Henry W. Fischer, Richard W, Christie, "Fifty-Year History of Movable Bridge Construction-Part I", and "Part II", Journal of the Construction Division, ASCE, September, 1975, pp. 511-543.

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MOVABLE SPAN BRIDGES IN MARYLAND revised 1/19/95

Name	No.	Route	Crossing	Type	Date
Stony Creek	2045	MD 173	Stony Creek	DLB	1947,86
Spa Creek	2053	MD 181	Spa Creek	DLB	1946
Ridgely Ave	2081	MD 436	Weems Creek	PST Swing	1929,82
Benedict	4008	MD 231	Patuxent R	TSG Swing	1950
	9001	MD 14	Marshyhope Cr	DLB (NO)	1931
Maryland Ave	9008	MD 342	Cambridge Cr	DLB	1938
Sassafras	14006	US 213	Sassafras R	SLB	1987
Chestertown	14027	US 213	Chester R	DLB	1930,90
Woodrow Wilson	16173	I-495	Potomac R	DLB	1961,84
Kent Narrows	17006	MD 18	Kent River	DLB	1952
Tilghman	20001	MD 33	Knapps Narrows	SLB(OC)	1934,71
Miles River	20018	MD 370	Miles R	SLB	1984
Dover Bridge	20023	MD 331	Choptank R	TST Swing	1932
Main Street	22009	MD 991	Wicomico R	DLB	1928,81
US 50-Salisbury	22028	US 50	Wicomico R	SLB	1962
Snow Hill	23002	MD 12	Pocomoke R	SLB	1932
Pocomoke	23004	MD 675	Pocomoke R	DLB	1920,89
Ocean City	23007	US 50	Sinepuxent Bay	DLB	1941,80
	B79	Wise Rd	Bear Creek	DLB	1943
	BC5217	Pennington	Curtis Creek	DLB	1976
	B147	Peninsula	Bear Creek	DLB	1958
Hanover St	BC5210	MD 2	Patapsco(Mid.Br)	DLB	1916

DBL=Double Leaf Bascule
SLB=Single Leaf Bascule
PST Swing=Pony Steel Truss Swing
TSG Swing=Through Steel Girder Swing
TST Swing=Through Steel Truss Swing
OC= Overhead Counterweight and NO= Not Operable

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GENERAL BRIDGE SIGNIFICANCE

The significance of bridges in Maryland is a difficult and subtle thing to gauge. The Modified significance criteria of the National Register, which are the standard for these judgements in Maryland, as in most states, must be broadly applied to allow for most of these structures. In particular the 50 year rule which specifies a minimum age for structures can be waived, and is more commonly done so for engineering structures than for others. Questions of uniqueness and typicality, exemplary types, etc., must set aside for now, because they presuppose a wider knowledge of the entire resources than is presently available. Indeed, this survey is an initial step toward understanding the extent to which Maryland's bridges are part of her cultural resources. Aesthetic considerations may have to be side-stepped entirely, for such structures as these are generally considered mundane and ordinary at best, and sometimes a negative landscape feature, by the layman. It does take a specialized aesthetic sense to appreciate such structures on visual grounds, but a case for visual significance can be made. The remaining criteria are those of historical associations. The relative youth of most of these structures precludes a strong likelihood of participation to events and lives of import. The best generalization can be made for most bridges is that they are built on site of early crossings, developing from fords and ferries through covered bridges and wooden trusses to their present state. This significance inheres in the site, however, and in most cases would not be diminished by the adsense of the present structure.

These criteria may also be addressed positively. The primary significance of these bridges, those which were built between the two World Wars, consists in their association with rapidly changing modes and trends in transportation in America during the period. The earliest of them saw the appearance of the automobile and its rise as the preëminent means of getting Americans from place to place. Roads were being improved for increased speeds and capacity, and bridges, as potential weak links on the system, became particularly important. The technology for producing them was not new, and would not change significantly during the period. Accordingly, great numbers of easily, quickly and relatively cheaply built concrete slab, beam and arch bridges were built to span the samll crossings, or were multiplied to cover longer crossings where height was no problem.

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Truss bridges with major structural members of compound beams, of either the Warren or Pratt types, while more expensive and considered more intrusive on the landscape, were built to span the larger gaps.

With an aesthetic which allowed concrete slab bridges to have classical balustrades, or the application of a jazz-age concrete relief; with the considerable variety possible in the construction of medium sized metal trusses; and with the lack of nationwide standards for highway bridge design, the resulting body of structures displays considerable variety. The sameness of appearance of currently produced highway bridges leads one to believe this variety will not reappear. For that reason alone it is wise to keep watch over our existing bridges. Regardless of ones taste and aesthetic preference, one must be admitted that these older bridges add their variety and visual interest to the environment as a whole, and that it is often the case that their replacement by a standard highway bridge results in a visual hole in the landscape.

In situations requiring decisions of potential effect on these structures, they should receive some consideration. As the recording and subsequent understanding of Maryland's Cultural resources grows, they will be recognized as a significant part of that heritage.

It should be noted that two non-negligible classes of structure have been omitted from this set. The first is the huge number of concrete slab or beam bridges of an average of twenty feet or less in length. These are so nearly ubiquitous and of such minor visual impact (they are often easy to drive across without noticing) that they were not inventoried. They are considered in the general recommendations section of the final report of this survey, however.

The second category is that of the "great" bridges, the huge steel crossings of the major waterways. While they are awesome and aesthetically appealing, they are not included in this inventory because they do not share the problems of their more modest counterparts. They do not lack for recognition, they have not been technologically outmoded, and are in no danger of disappearing through replacement. In a sense, they are not as rare; hundreds of

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these great bridges are known nationally, and there is little doubt as to the position of any one bridge within national spectrum. There seems little point in including them with the larger inventory of bridges. From an arbitrary point of view, their dates are outside the 1935 limit which we set for the consideration of bridges. We have departed from that limit on occasion, but will not in this case. These bridges, too, will be considered in the final report.

Moveable bridges deserve a special note regarding their significance. They are rare, and all but the most recent of them have been listed by this survey by virtue of that fact alone. They are, by their nature as intermittent impediments to the smooth flow of traffic, threatened. We rarely tolerate disruptions to what we perceive as our progress. This has been demonstrated recently by the replacement of the drawbridge at Denton, on one of the major routes to the Atlantic Coast from the rest of Maryland.

However much we are inconvenienced by them, we must admit that moveable bridges contribute a share of interest to the landscape. As with significance judgements in general, we here enter a realm which is governed by taste and opinion. Some of us might not enjoy being forced to site back for a while to look at the surroundings which we would otherwise totally ignore, especially if the engine is in danger of boiling over. But there are those who are fascinated by the slow rise of a great chunk of roadway, moved by quit, often invisible machinery; who are amused by the tip of the mast which skims the top of the temporary wall; or who reflect on the nobility inherent in a river and the fact that we have not subdued every waterway with our autos, while knowing that we can if we want to.

EASTON 3 M
CHESAPEAKE BAY BRIDGE 7.5 M
BALTIMORE 23 MI
ARNOLD 2.5 MI.

SOUTH RIVER QUADRANGLE
MARYLAND—ANNE ARUNDEL CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

5762 III SW
(GIBSON ISLAND)

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Weems CReek Bridge
M/DOT
Hnedak/Meyer
November 1980